WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
and
WYOMING DEPARTMENT OF AGRICULTURE

SOLID WASTE GUIDELINE #17

GUIDANCE FOR COMPOSTING ANIMAL MORTALITIES AT FARMS, RANCHES AND EXEMPT ANIMAL FEEDING OPERATION FACILITIES

This Guidance is intended only for farms, ranches and animal feeding operation facilities that are exempt from the waste management permitting requirements of the Wyoming Department of Environmental Quality's (WDEQ) Solid and Hazardous Waste Rules and Regulations (SWRR). This purpose of this Guidance is to provide recommendations to farmers, ranchers and exempt animal feeding operation facilities for composting animals that have died on their premises. The recommendations include information about locating, designing, constructing, operating and closing dead animal composting facilities.

(*Note: Potentially exempt facilities are defined in SWRR Chapter 1. Exempt facilities include: 1) lands and facilities owned by a person engaged in farming or ranching and used to dispose of waste generated incidental to his or her farming and ranching operation, or; 2) concentrated animal feeding operations (CAFO) that confine and feed less than 1,000 slaughter and feeder cattle, 700 mature dairy cattle, 2,500 swine each weighing over 55 pounds, 500 horses, 10,000 sheep or lambs, 55,000 turkeys, 30,000 laying hens or broilers or 5,000 ducks. A CAFO is a facility where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period and crops, vegetation forage growth, or post-harvest residues are not sustained over the normal growing season over any portion of the lot or facility. Facilities that do not meet the SWRR Chapter 1 exemptions should contact WDEQ to obtain information about permitting requirements prior to constructing a composting facility*.)

Definitions

Composting means the biological decomposition of animal carcasses and offal, under controlled conditions, to a state where the storage, handling, and land application can be achieved without adversely affecting the environment.

Completely composted means to leave a carcass, carcass part or offal in a composting facility until there is no visual evidence of soft tissue or bones which have not demineralized before land application.

Composting facility means the facility and the area located on the premises where the livestock died and/or transported to which are used for composting, storing composting materials, and storing compost.

Disease vector means, but is not limited to, rodents, flies, mosquitoes, or other pests capable of transmitting diseases to animals.

Leachate means liquid which has been produced by the decomposition of animal carcasses or feedstocks during the composting process, which seeps from the compost material.

Animal carcasses means the dead bodies, or the parts thereof, of cattle, swine, sheep, horses, goats, ratite birds and poultry, fish, and cervine.

1. What are the options available for animal mortality disposal?

Animal mortality and disposal of those animals is a concern on both small farms and ranches and larger scale animal feeding operations. The available acceptable options for dead animal disposal are burial, incineration, rendering, disposal at a permitted municipal solid waste landfill and composting. In areas of sparse population, leaving the carcass where death occurred is still an option. Due to availability, transportation and/or cost constraints, incineration, rendering and disposal at a landfill may not be viable disposal methods. Burial of animal mortalities may be problematic for efficient land utilization and poses potential groundwater pollution. Because of these limitations, composting has become a useful option that offers an economical and environmentally friendly way of disposing animal mortalities and recycling nutrients contained in the carcasses.

2. What is composting?

Composting is a controlled biological decomposition process in an aerobic (oxygen rich) environment that reduces plant, animal and other organic matter to a material that resembles humus (dark granular material with very little odor). The composted material can be land applied and is beneficial to growing plants.

3. What types of animals can be composted?

It is possible to compost livestock carcasses of any size, however, the majority of information available regarding design and operation of a composting facility is for

smaller animals ranging from chickens to swine. The limited information available regarding composting larger animals, such as cattle, indicates the processes are the same but the composting time may be longer.

4. Where should the composting facility be located?

The facility must be located on the property owned by the owner of the farm, ranch or animal feeding facility where the animal died to be eligible for exemption. In order to help ensure operation of the facility does not negatively affect residents or the public, or potentially pollute surface water or ground water, WDEQ and WDA recommend that the site selected for the facility addresses the following:

- the location should be an adequate size to accommodate construction and operation of the facility, including storage and traffic needs;
- the location should not be in conflict with local zoning ordinances and land use plans adopted by a county commission or municipality;
- the location should be on a low permeability soil-type (e.g., soils with high clay content; avoid sandy soils) to minimize infiltration of decomposition material into the subsurface that could then potentially pollute ground water;
- the location should be on higher ground to help avoid flooding problems and storm water entering and contacting the composting material;
- the location should not be within a floodplain, wetland or drainage area;
- the location should be in an area of the property where the high groundwater table is expected to be deepest;
- the location should be at least 1,000 feet away from any well, perennial lake or pond, and at least 300 feet away from any perennial stream, river, industrial process water or storm water management pond;
- the location should be at least 1,000 feet away from any house, school or hospital, public park, recreation area or public highway right-of-way unless the facility is screened from view by trees, fences or other appropriate means;
- the location should not be where there is a potential for the facility to present odor problem or public nuisance problems unless these problems can be adequately controlled;
- prevailing winds should be taken into consideration when choosing a location for the composting process.

5. How should the composting facility be designed and constructed?

The facility should be designed and constructed to include a crowned surface (pad) for primary and secondary composting bins or windrows, a soil berm around the pad, large enough to collect and hold precipitation run-off, storage of composting materials (e.g., sawdust), and storage of finished compost material and operating equipment, as applicable. The pad should be graded to prevent precipitation entering the bermed area

and to prevent ponding within the bermed area. The area should also be large enough to accommodate access and operating equipment needs.

Sizing of the composting facility is critical for successful operation. Composting facilities that are undersized may have problems with odors and flies (also other disease vectors). Proper sizing will make the operation and management of the composting process easier. The size of the facility should be large enough to accommodate all components described above. Each pile should be large enough to accommodate the number of dead animals placed in a base layer (refer to Question #6 below).

6. How should the composting facility be operated?

The primary objectives of a successful composting facility is biological decomposition of animal mortalities under controlled conditions to a state where storage, handling, and land application can occur, while protecting surface water and ground water from pollution, reducing or eliminating the risk of the spread of disease, eliminating nuisances such as odors, vectors, vermin and scavenging animals, and maintaining air quality. The recommendations contained in this Guidance are intended to help a facility meet these objectives. However, some adjustments may be necessary to address individual circumstances.

While composting occurs naturally, the process requires proper conditions to occur rapidly, minimize odors and prevent nuisance problems. The four components to adhere to for successful operation are the appropriate carbon/nitrogen balance, temperature, moisture levels in the pile and porosity of the compost material mix. Each of these components is described in more detail below.

Carbon/Nitrogen Balance

The proper compost mix requires both carbon and nitrogen at the proper C/N ratio (25:1 to 30:1 is satisfactory). Animal mortality material generally has a C/N ratio that is too low to compost, and therefore requires an amendment that contains a high C/N ratio. Plant materials such as wood chips, sawdust or straw are types of amendments that may be used. While wood chips and straw have large particle size and may not work as well as sawdust initially, they may be ground to facilitate more complete composting. The amount of amendment to use is described later in this section.

Temperature

Bacteria that require oxygen to flourish (aerobic bacteria), grow at temperatures ranging from 100 ˚F to 150 ˚F. Heat is generated as the bacteria begin to break down the animal mortality material in the pile. As the temperature increases in the pile, the mass of composting material will be more active and broken down faster. At temperatures above 150˚ F, the rate of decomposition will decrease as bacteria are inactivated, or even destroyed by the excessive temperatures.

As the pile heats up, warm air within the mixture will rise and move out of the pile, while fresh air will be drawn into the pile. This process maintains an aerobic (oxygen rich) environment for the bacteria. In addition, temperatures that remain above 130˚ F for three days will destroy many disease causing bacteria within the pile. Note that temperatures reached within the pile may not destroy all types of bacteria, viruses or abnormal proteins (e.g., the protein that causes "mad cow" disease). At this time, composting is not recommended if mortality is caused by a known incidence of Bovine Spongiform Encephalopathy ("mad cow" disease) or other serious transmittable diseases. Facilities can obtain additional information from the State Veterinarian or WDA regarding their specific situation.

The composting pile will generate heat and regulate its own temperature. However, to maintain high temperatures, the pile must have some insulation. A layer of inactive material (e.g., sawdust, manure or finished compost) placed over the entire pile will provide such insulation. The insulation layer should be at least two feet in depth.

Temperature should be regularly monitored at several points near the dead animals in the pile. Temperature recording can be done with thermometer with a probe sufficient to test the temperatures deep in the composting material.

Moisture Levels and Porosity

Proper moisture levels and a stable porous structure for the composting mass are two other conditions required for proper composting. To encourage bacterial growth and rapid composting, the mixture should have 50% to 60% moisture content. If a handful of the mixture feels moist, but no water drips from it when squeezed, the mixture probably has adequate moisture.

Compost Facility Operation and Management

Under controlled conditions, composting is usually done in two stages, primary and secondary composting. In the primary stage, a high rate of biological activity results in rapid decomposition and high temperatures in the pile. The second stage has lower biological activity resulting in slower decomposition and lower pile temperatures. The secondary stage allows the compost to complete the biological activity and stabilize, also called curing.

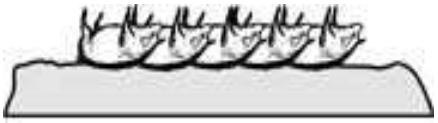
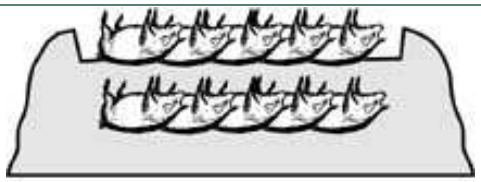
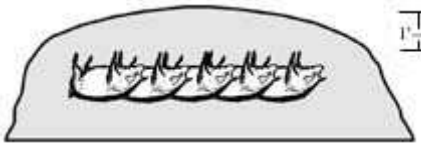
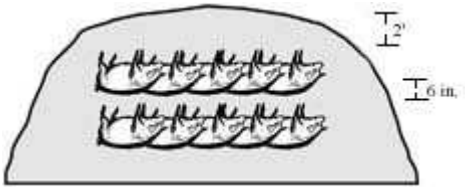
Starting a compost Pile	Adding Pigs to a compost Pile
 **Sawdust base 1 to 2 feet deep.**	 **Skim off top sawdust.**
 **Place layer of pigs on base.**	 **Place new layer of pigs on pile.**
 **Cover with two feet of sawdust.**	 **Re-cover layer of pigs with 2 ft. sawdust.**

Figure. Construction of a composting pile for swine mortality.

H. Keener, D. Elwell, T. Mescher, 1999. Composting Swine Mortality Principles and Operation. Ohio State University Extension Fact Sheet, Food Agricultural and Biological Engineering. May.

1. Start a primary pile by placing one to two feet of a high carbon / nitrogen amendment (e.g., sawdust, manure, other absorbent material) on the base layer of the primary stage bin or windrow. Depending on the species involved, carcasses may be arranged on the base layer in a manner that will achieve a manageable bin or windrow. The base will collect liquids that are released from carcass decomposition. It also permits air and microbial action underneath the carcasses.
2. Carcasses may be placed on the base layer one layer deep or may be layered two or three carcasses deep. Amendment material may be placed between layers of carcasses, but is not required to achieve composting. Large carcasses can be layered or placed in contact with another carcass without detrimental effects to the composting process. Layers of large carcasses should be not more than three carcasses deep and two layers is advisable.
3. Generally, 12 cubic yards of amendment is needed for the base and cover for each 1000 pounds of animal carcass or material composted.
4. Keep the surface of the pile shaped to help precipitation run off. As the pile settles, add amendment to the top of the pile as the pile settles.
5. A maximum of two layers is recommended to reduce the potential for developing high temperatures. High temperatures will cause anaerobic (lack of oxygen) conditions, odors and liquids that may leach from the pile.
6. Cover the top layer of carcasses with two feet of amendment. Maintaining two feet of cover will help control odor, help control flies, insulate the pile to retain heat and minimize attraction of scavenging animals.

7. Additional carcasses may be added to the pile by removing a portion of the top or end layer of amendment, placing the carcasses in a single layer, and recovering with at least two feet of amendment.

8. After the last animal has been added to the bin or windrow, allow the bin or windrow to compost for 60 to 90 days. Manage the composting process carefully by checking temperatures and intervene only if necessary to maintain composting process. If problems with the composting process are evident, correct the problem immediately to preserve the composting process. Refer to Question # 8 below for information to help resolve problems that may be encountered with high or low temperature or moisture content.

9. Monitor the temperature and moisture content regularly as described above to ensure optimum composting conditions. Once the pile reaches 130º F, it should stay above that temperature for at least one week. Start counting the days of composting when the temperature reaches 130º F in the area of the pile that had the last carcasses added. It is recommended that a record is kept to track composting progress and to identify potential problems. Refer to Question #8 below for information to help resolve problems that may be encountered with high or low temperature or moisture content.

10. If a bin is employed in the composting method, move the composted material from the primary stage bin to the secondary stage bin for further composting when the temperature drops. This allows oxygen to be reintroduced to the composting material in the bin. Carcasses should be completely decomposed (i.e., the only recognizable parts are larger bones, teeth and pieces of hide; bones should be rubbery and calcified).

If a windrow is the method of choice, the windrow may be stirred, turned, or mixed by using a compost turner, which moves down the windrow and stirs the material in place, to allow the reintroduction of oxygen to the composting material.

11. Allow composting to continue (curing) in the secondary stage pile for another 60 to 90 days or until the composting material resembles humus (dark granular material with very little odor). Some bone and teeth material may remain, especially for larger animals, but it should be soft and easily crumbled. If any bones or teeth remain, they can be reintroduced to another composting bin or windrow. Curing is a very critical stage that occurs at low temperatures. Compost that is not completely cured may contain high levels of organic acids and a high C/N ratio that can damage certain horticultural applications.

7. What are the uses of composted material?

Composted material can be used as an amendment (i.e., in addition to or as a replacement of sawdust) for additional primary stage pile composting operations, or it can be land applied as a soil amendment for plant growth. Compost should be land applied at agronomic rates for the crop being grown. Composted material may be tested for content prior to land application. The soil, to which the compost is to be applied, should also be tested to determine the amount of compost needed. Compost content will vary with materials used in the composting process.

8. What are some of the problems that may be encountered with composting and how can they be resolved?

1. If temperatures in the pile are too high liquids may be generated. If liquids begin to leach out of the composting pile, or precipitation runoff from the pile accumulates in the bermed area, use sawdust to absorb the liquids and place back on the pile. Additional dry sawdust may be needed in the pile to absorb moisture and reactivate composting. If the composting process cannot be recovered, moving the pile to another pile location with additional amendments may be necessary. For construction of subsequent piles, increase the depth of the base. Reassess the construction site and the berm construction if problem precipitation runoff continues.
2. There are several reasons odors may be a problem. One is that there is insufficient amendment cover. This problem can be resolved by adding amendment as cover to the pile. Another cause for odors is that the temperature or material mix porosity is too low or high. Either of these conditions may cause anaerobic (lack of oxygen) conditions. The pile may be turned or aerated to reintroduce oxygen and reactivate or increase microbial activity.
3. Too much moisture may cause anaerobic (lack of oxygen) conditions which will cause the composting process to be less effective. A sawdust cover on the pile helps precipitation run off, especially during the spring or high precipitation events. If moisture content is too high for an extended period of time, additional amendment and turning the pile may be necessary. During dry periods, adding water may be necessary to maintain the optimum moisture content.
4. Beginning a compost operation in cold weather slows the compost process, however once warmer weather arrives decomposition should accelerate with increased temperatures in the pile. A pile that already has high temperatures should not be affected by the onset of cold weather.

9. How should the composting facility be closed?

Prior to closing the facility, all composting processes should be complete. Composted material from the secondary stage pile should be removed and land applied as described in Question #7 above. The berms should be removed, and the piles area graded to prevent ponding of surface water. Plant the area, as appropriate. In addition, it is recommended that equipment, tools, containers, etc. that may have come in contact with dead animals or compost material should be disinfected with a bacteriological/viralcidal agent.

10. Where can more information be obtained about composting dead animals?

For more information, please contact the Wyoming Department of Environmental Quality at (307) 777-7752 or the Wyoming Department of Agriculture at (307) 777-7211

11. References

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